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**Internet Links to Further Information about Community-Acquired Pneumonia:**

[www.lungusa.org/diseases/lungpneumoni.html](http://www.lungusa.org/diseases/lungpneumoni.html)  
[www.mayoclinic.org](http://www.mayoclinic.org)  
[www.cdc.gov/nchs/fastats/pneumonia.html](http://www.cdc.gov/nchs/fastats/pneumonia.html)  
[www.lungusa.org/diseases/pneumonia\\_factsheet.html](http://www.lungusa.org/diseases/pneumonia_factsheet.html)

The purpose of this section of the Technical Appendix is to provide yearly detailed statistical results associated with community-acquired pneumonia (CAP) 30-day mortality in California hospitals. Yearly statistics might enable hospitals to analyze trends associated with quality improvement efforts. The summary results shown in Part A of this report are based on the same discharge data as the yearly, detailed statistics.

## An Example Table

**Table A.18: Statistics for Community-Acquired Pneumonia (CAP) Mortality at Hypothetical General Hospital**

Model: Statistics:	Without DNR				With DNR			
	All Years	1999	2000	2001	All Years	1999	2000	2001
Statewide Death Rate (percent)	12.23	11.72	12.53	12.57	12.23	11.72	12.53	12.57
Number of Cases Included	353	130	131	92	353	130	131	92
Number of Observed Deaths	37	10	18	9	37	10	18	9
Number of Expected Deaths	48.53	15.68	19.14	13.88	52.78	15.29	23.01	14.65
Observed Death Rate (percent)	10.48	7.69	13.74	9.78	10.48	7.69	13.74	9.78
Expected Death Rate (percent)	13.75	12.07	14.61	15.08	14.95	11.76	17.57	15.92
Risk Adjusted Death Rate (RADR) (percent)	9.32	7.47	11.78	8.15	8.57	7.66	9.80	7.72
RADR Lower Bound: 90 percent CI	6.87	2.96	7.75	3.62	6.29	3.39	6.31	3.45
RADR Upper Bound: 90 percent CI	11.78	11.99	15.81	12.69	10.85	11.94	13.29	12.00
RADR Lower Bound: 95 percent CI	6.39	2.42	6.98	2.75	5.85	2.57	5.64	2.63
RADR Upper Bound: 95 percent CI	12.25	12.53	16.58	13.56	11.29	12.76	13.96	12.82
RADR Lower Bound: 98 percent CI	5.85	1.47	6.08	1.74	5.35	1.62	4.87	1.68
RADR Upper Bound: 98 percent CI	12.80	13.48	17.48	14.57	11.80	13.71	14.73	13.77
Probability This Rate Occurred by Chance	0.031	0.061	0.442	0.069	0.005	0.074	0.122	0.038

Table A.18 summarizes the results for a Hypothetical General Hospital. The first column on the left identifies the year(s) of data included in the results. The outcome is death within 30 days after admission for the index CAP admission.

The model used to risk adjust the reported outcomes is described in general terms in the *Part A* of this report and in detail in this appendix.

The results are displayed year-by-year as well as for all years combined. For example, the results in a row labeled "1999" include only eligible patients discharged from the hospital for CAP in 1999. The row labeled "All Years" includes all eligible patients in 1999, 2000, and 2001 combined. Some hospitals do not have any CAP patients in a particular year, but do have patients in other years. In this case, the row corresponding to the year in which the hospital had no cases would be blank.

The hypothetical General Hospital shown in Table A.18 is used as an example for the following explanation of hospital-level summary statistics (only model "without DNR" is discussed here, same definition applies to the model "with DNR").

The Statewide Death Rate (percent) is the total number of patients included in this report who died within 30 days of admission, divided by the total number of patients included in this report,

multiplied by 100. As Table A.18 shows, the overall *Statewide Death Rate* for CAP during 1999-2001 was 12.23 percent.

The Number of Cases Included tells how many cases from each hospital were selected for risk-adjustment. A general description of patient inclusion and exclusion criteria is provided in Part A of this report and a detailed description is provided in this appendix.

The Number of Observed Deaths is the number of patients at a facility who died within 30 days of admission for CAP. The death may have occurred at the index hospital, a transfer hospital, or outside the hospital setting.

The Number of Expected Deaths among patients included in the analysis is presented in the next row. The influence of patient characteristics on the risk of death was estimated from the risk-adjustment model. A predicted probability of death was computed for each patient. Summing these probabilities over all patients treated at a hospital gave the predicted number of deaths among those patients.

The Observed Death Rate (percent) is the number of patients at this hospital who died, divided by the number of patients at this hospital included in the analysis, multiplied by 100. The overall *Observed Death Rate* for CAP is  $(37/353) \times 100$ , or 10.48 percent.

The Expected Death Rate (percent) is the expected number of patients at this hospital who died, divided by the number of patients at this hospital included in the analysis, multiplied by 100. Hypothetical General had 353 CAP patients. With 48.53 patients expected to die, the *Expected Death Rate* is 13.75 percent.

The Risk-Adjusted Death Rate (percent) is derived using a technique known as indirect standardization. It adjusts the observed death rate at the hospital to reflect what the rate would be if the patients were about as ill as the "average" patient in the State. The *Risk-Adjusted Death Rate (percent)* is calculated as the statewide rate, multiplied by the ratio of the number of *observed* deaths to the number of *expected* deaths at this hospital. This adjusted death rate can be used to compare the performance of different hospitals.

At this hypothetical hospital, 37 patients died whereas 48.53 were expected to die. The risk-adjusted death rate is  $12.23 \text{ percent} \times (37/48.53) = 9.32 \text{ percent}$ . Adjusting for patient mix, the risk-adjusted death rate is lower than its observed rate of 10.48 percent.

Note that the expected death rate 13.75 percent is higher than the statewide rate (12.23 percent). This difference reflects the fact that patients at the hypothetical hospital had higher risk, on average, than the statewide population of patients. The risk-adjusted figure of 9.32 is an estimate of what the death rate would be at the hypothetical hospital if its patients matched the state average in terms of risk.

The Risk-Adjusted Confidence Bounds reflect the level of confidence in the hospital's risk-adjusted death rate. For example, with the 98 percent confidence bounds, assuming that the risk model is correct, there is a 98 percent chance that the hospital's true risk-adjusted CAP death rate falls between the *Lower 98 percent Confidence Bound* of 5.85 percent and the *Upper 98 percent Confidence Bound* of 12.80 percent. Narrower intervals, providing 90 percent and 95 percent confidence in addition to 98 percent confidence, are provided in these tables for the benefit of individual hospitals and physician groups that are interested in evaluating their performance using more liberal statistical criteria.

The Probability this Rate Occurred by Chance is a measure of the likelihood that this many (or more) deaths occurred by chance, given the expected number of deaths from the risk-adjustment model. If the observed number of deaths is less than or equal to the expected

number, a *lower p-value* is computed. If the observed number of deaths is more than the expected number, an *upper p-value* is computed.

The lower p-value is the probability of the observed number of deaths or fewer. The lower p-value represents a "test" of whether this hospital has systematically **better** outcomes than expected based on its patients' risk characteristics. A lower p-value of less than 0.05 indicates that there would be less than a 1 in 20 chance of this hospital having this few or fewer deaths, given its mix of patients, if quality of care were average.

The upper p-value is the probability of the observed number of deaths or more. The upper p-value represents a "test" of whether this hospital has systematically **worse** outcomes than expected based on its patients' risk characteristics. An upper p-value of less than 0.05 indicates that there would be less than a 1 in 20 chance of this hospital having this many or more deaths, given its mix of patients, if quality of care were average.

Because the hospital had fewer deaths than expected, the lower p-value of 0.031 was used. Thus, in this hospital with 353 patients (and 48.53 expected deaths), the probability of observing 37 or fewer deaths due to chance alone is about 3 in 100. Such a finding proves that the hospital's outcomes differ significantly from the statewide average at 90 percent confidence boundary, but not at 95 and 98 percent boundary, which are more conservative criteria. In order to be significant at 98 percent confidence interval, the probability this rate occurred by chance has to be less than 0.01. The pair numbers for 95 percent and 90 percent confidence interval are 0.025 and 0.05 respectively. Thus, the criteria of 90 percent, 95 percent and 98 percent is from liberal to more conservative one.

The classification of hospitals into one of four categories in the main report, based on all three years of data, was based on a p-value of 0.01. Hospitals classified as significantly better than expected had fewer deaths than expected and a lower p-value of less than 0.01. Hospitals classified as significantly worse than expected had more deaths than expected and an upper p-value of less than 0.01. When two separate one-tailed tests using p-values of 0.01 are combined, they create the equivalent of a 98 percent confidence interval. While the significant tests used here are based on either one of two "directional" one-tail tests that show hospitals as either significantly better or significantly worse than average, the calculation of the "non-directional" confidence interval boundaries is based on a 98 percent level of confidence. To help hospitals look the risk-adjusted rate in a "loosing" standard, both 95 percent and 90 percent confidence intervals, in addition 98 percent confidence interval, are provided in the detail statistics table delivered to each hospital.

Summarizing the contents of Table A.18, the hypothetical hospital has an overall risk-adjusted death rate of 9.32 percent. This rate is lower than the overall statewide death rate of 12.23 percent, but is not statistically significant.

For all California hospitals that admitted CAP patients between 1999 and 2001, detailed statistical tables following the format of Table A.18 may be found at: [www.oshpd.ca.gov](http://www.oshpd.ca.gov).